(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 932 240 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.07.1999 Bulletin 1999/30

(51) Int. Cl.[6]: **H02J 7/02**, H01M 10/48, G01R 31/36, B60L 11/18

(21) Application number: **98124419.7**

(22) Date of filing: **22.12.1998**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **26.12.1997 JP 35918497**

(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku, Tokyo 101-8010 (JP)

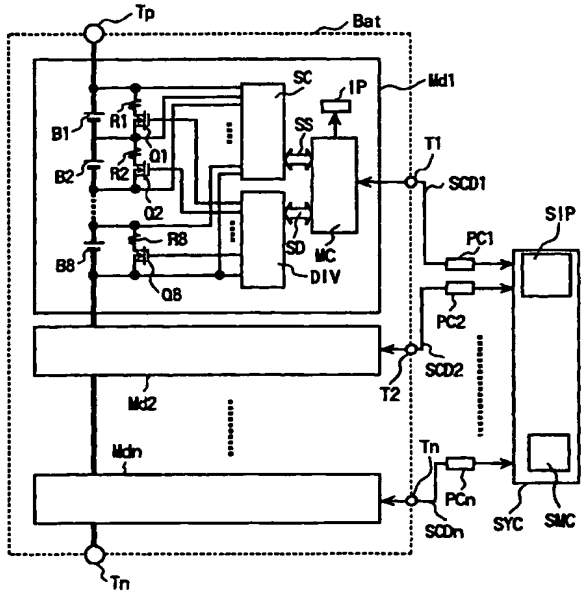
(72) Inventors:
- **Takahashi, Tadashi**
  Hitachi-shi, Ibaraki 319-1225 (JP)
- **Kumashiro, Yoshiaki**
  Hitachi-shi, Ibaraki 316-0006 (JP)
- **Emori, Akihiko**
  Hitachi-shi, Ibaraki 316-0014 (JP)
- **Miyazaki, Hideki**
  Hitachi-shi, Ibaraki 319-1413 (JP)

(74) Representative:
Beetz & Partner
Patentanwälte
Steinsdorfstrasse 10
80538 München (DE)

(54) Battery system and electric vehicle using the battery system

(57) A battery system includes a battery assembly (Bat) including a plurality of modules (Md), which is controlled by a system control circuit (SYC), each module including a module control circuit (MC) and a module by-pass circuit (R, Q) which is controlled via the module control circuit (MC) so as to suppress the charging variation among the plurality of modules (Md); wherein each control circuit (MC) and the system-controlling circuit (SYC) is connected to each other with a bilateral transmission means (SCD), and each module by-pass circuit (R, Q) is controlled based on information bilaterally transmitted between each module control circuit (MC) and the system control circuit (SYC) via the bilateral transmission means (SCD).

FIG.1



EP 0 932 240 A2

SDOCID: <EP__0932240A2_I_>

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a battery system, and especially to a battery system composed of a plurality of lithium battery modules connected to each other, which is used in an electric vehicle.

[0002] The lithium battery has recently become known as a light-weight, high power-density battery with a large capacity, which is suitable for an electric vehicle. However, since lithium batteries have a low tolerance level against over-charging and over-discharging, the misuse of a lithium battery may cause a fire or an explosion. Therefore, it is necessary to monitor and control the terminal voltage of a lithium battery.

[0003] A conventional battery system composed of a plurality of modules serially connected to each other, each module including cell batteries serially connected to each other is disclosed, for example in a paper "Advanced Battery System for Electric Vehicle," EVS-13, Osaka, Japan. Each module is controlled by a cell controller. A by-pass circuit is provided in each cell, and the cell controller controls each module so that any charging variation among the cells in each module is suppressed. The total battery system is controlled by a battery controller, and each cell controller sends signals to the battery controller.

[0004] As mentioned above, although the conventional battery system controls the charging-balance among the cells in each module, the system does not take the charging variation among the modules into consideration. However, in a battery system composed of many modules serially connected to each other, if there is a charging variation among the modules, the terminal voltage of only some of the modules attains the rated terminal voltage, and the terminal voltage of the rest remains under the rated terminal voltage, Accordingly, the full capacity of the battery system cannot be achieved. Furthermore, if there exists a charging variation among the modules, it also causes the variation in the length of their life cycles.

SUMMARY OF THE INVENTION

[0005] An object of the present invention is to suppress the charging variation among modules.

[0006] The above object is attained by providing a by-pass circuit in each module and controlling the by-pass circuit via a module-controlling circuit. Furthermore, the charging variation among the modules is reduced by controlling each by-pass circuit based on information bilaterally transmitted between each module-controlling circuit and a system-controlling circuit.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Fig. 1 shows a schematic composition of a battery system of an embodiment according to the present invention.

Fig. 2 shows a schematic composition of a battery system of another embodiment according to the present invention.

Fig. 3 is a main flow chart of a software program executed in the embodiments according to the present invention.

Fig. 4 is a flow chart of a subroutine SUB1 executed in the program shown in Fig. 3.

Fig. 5 is a flow chart of a subroutine SUB2 executed in the software shown in Fig. 3.

IFig. 6 shows the composition of a hybrid electric vehicle of still another embodiment according to the present invention.

Fig. 7 is a simplified diagram showing an example of the composition of a battery system according to the present invention.

Fig. 8 is a diagram showing an example of the composition of a battery module used in the battery system according to the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0008] To begin with, respective examples of an electric vehicle and a battery system used in a hybrid electric vehicle (HEV) are explained below with reference to Fig. 6 and Fig. 7. Fig. 6 shows the composition of a hybrid electric vehicle. reference symbols Car and SH indicate the body of the electric car and the steering wheel, respectively. Moreover, reference symbols ShF and ShB indicate front and back seats. Reference symbol Bat indicates a battery assembly composed of modules Md1 - Mdn (only six modules Md1 - Md6 are shown in Fig. 6.) Also, each module is composed of a plurality of battery cells (hereafter referred to as cells.) Reference symbol Eng indicates an engine, and the energy generated in this engine rotates wheels and generates power by driving a generator Gen at the same time. Furthermore, the battery assembly Bat is charged by the generated power via a charger Cha. Also, a capacitor Co is connected to the battery assembly Bat in parallel, and the energy accumulated in the battery assembly Bat rotates the wheels HL by driving a motor generator MG via an inverter Inv. Furthermore, the motor generator MG is driven by the wheels HL during a braking operation, and the power generated by the motor generator MG is charged in the battery assembly Bat by a regenerative operation of the inverter Inv. Also, the engine Eng generates power by driving a generator Gen, and charges the battery assembly Bat via the charger Cha. The above-mentioned operations in the electric vehicle are controlled by a system-controlling

IOCID: <EP___0932240A2_I_>

circuit SYC which, while using the battery assembly Bat, the inverter Inv, and the charger Cha, transmits information along signal flows shown by dotted lines with arrows. In Fig. 6, fat lines with arrows indicate energy flows, and the dotted lines with arrows indicate signal flows.

[0009] Meanwhile, in other examples of an HEV system, an engine Eng is sometimes connected to a motor generator MG, and a generator Gen and a charger Cha are omitted.

[0010] Fig. 7 is a simplified diagram showing an example of the composition of a battery system. The battery assembly Bat is composed of a plurality of battery modules (hereafter, a battery module is referred to as a module Md) serially connected to each other. Moreover, each module is also composed of a plurality of cells serially connected to each other. There are two methods of charging the battery assembly Bat: a method of charging the battery assembly Bat with power generated by the generator Gen installed in the HEV via the charger Cha, and a method of charging the battery assembly Bat with power generated by the motor generator MG using the energy generated in a braking operation. Moreover, it is also possible to charge the battery assembly Bat by using an AC power source via the charger Cha at a charging station. In the discharging operation of the battery assembly Bat, the motor generator MG is driven by the discharged energy via the inverter Inv, and it drives the wheels HL. The above-mentioned operations are controlled by a system-controlling circuit SYC while using the battery assembly Bat, the inverter Inv, and the charger Cha.

[0011] Fig. 8 is a diagram showing an example of the composition of a battery module used in the battery system. Each module is composed of eight cells B1 - B8 serially connected to each other. Reference symbols Tr+ and Tr- indicate the positive and negative electrode terminals. Reference symbol CM indicates a module-controlling circuit, and includes the terminal voltage-detection unit SC, a microcomputer MC, a driver unit DIV, and semiconductor elements.

[0012] Fig. 1 shows the schematic composition of a battery system of an embodiment according to the present invention. Moreover, this figure shows the relationship between the system control unit SYC and the battery assembly Bat composed of modules Md1 - Mdn. In this embodiment, the module Md1 includes eight cells B1 - B8. Here, both terminals of a circuit composed of a resistor R and a semiconductor element Q serially connected to each other are connected to the positive and negative terminals of the cell B1 in parallel, and the same circuit is also connected to each of the rest of cells B2 - B8, in parallel. The semiconductor elements Q1 - Q8 are driven by the driver DIV in response to an instruction sent from the microcomputer MC. Moreover, the positive and negative electrode terminals of each of the cells B1 - B8 are connected to the terminal voltage-detection unit SC, and the terminal voltage of each cell is measured by the terminal voltage-detection unit SC. The value of the measured terminal voltage is sent to the microcomputer MC via a drive bus DS. Also, the microcomputer MC and the driver DIV are connected to each other via the drive bus DS. A display device IP is connected to the microcomputer MC, and displays necessary information - such that regarding as a anomaly state - according to an instruction sent from the microcomputer MC. As shown in Fig. 1, the modules Md1 - Mdn are serially connected, and the positive electrode terminal of the module Md1 and the negative electrode terminal of the module Mdn are connected to the positive and negative electrode terminals Tp and Tn of the battery assembly Bat, respectively. Moreover, the module Md1 is connected to the system control unit SYC via an isolation device PC1. Also, the module Md1 is connected to the isolation device PC1 via a bus SCD1. In the same manner, each of the modules Md2 - Mdn is connected to the system control unit SYC via each of isolation devices PC2 - PCn. The system control unit SYC is controlled by the microcomputer MC, and displays necessary information - such that regarding as anomaly states - on a display panel SIP according to an instruction sent from the microcomputer MC.

[0013] The reason why a plurality of cells are integrated into a module, and a plurality of modules are integrated into a battery assembly is that since the tolerance level against over-charging or over-discharging is low in a lithium battery, and a misuse may lead to a fire or an explosion, the safety is improved by dividing cells into blocks or modules. In addition, it is also that since the terminal voltage of a lithium battery cell is as high as 3 - 4V, if eight cells are serially connected into a module, the terminal voltage of the module is in a safe terminal voltage range of 24 - 32V, and the module can be easily operated. Furthermore, since the terminal voltage of each module is 24 - 32V or less, and circuit elements for the above terminal voltage range are sufficiently obtained, the system control unit SYC can be cheaply fabricated. Furthermore, since the total terminal voltage of the battery assembly Bat is more than 300V, it is necessary to isolate each module from the system control unit SYC by using each isolation device PC.

[0014] Now, the operation of the module Md1 shown in Fig. 1 is explained below. The terminal voltage of each of cells B1 - B8 is read into the microcomputer MC in the module. The microcomputer MC monitors the terminal voltage of each of cells B1 - B8. In order to suppress the charging variation, if it is detected that some one of the cells has a particularly high terminal voltage, the charging current flowing toward the cell is shunted to its cell by-pass circuit by turning on its cell by-pass circuit composed of the resistor R and the semiconductor element Q. Accordingly, since the charging current flowing into the cell becomes smaller than that in the other cells, the terminal voltage of the cell gradually decreases almost to the terminal voltage level of the other cells. Furthermore, if the terminal voltage of the

EDOCID: <EP___0932240A2_I_>

cell becomes equal to the terminal voltage level of the other cells, the by-pass circuit is turned off. Thus, the charging variation among the cells in each module is suppressed in each module.

[0015] Next, if the charging variation the among modules Md becomes large, the system control unit SYC determines which module has a higher terminal voltage and sends a control signal to each module based on information transmitted between the microcomputer MC in each module and the microcomputer SMC in the system control unit SYC. For example, if the terminal voltage value of the module Md1 is higher by a predetermined value than terminal voltage values of the other modules, the microcomputer SMC in the system control unit SYC sends a control signal to turn on all the cell by-pass circuits in the module Md1. Thus, since the charging current flowing in the module Md1 decreases to a level lower than that of the other modules, the terminal voltage value of the module Md1 gradually decreases to a level almost equal to the terminal voltage values of the other modules.

[0016] Fig. 2 shows the schematic composition of a battery system of another embodiment according to the present invention.

A component with the same reference symbol as that shown in Fig. 1 performs the same operation as that of a component of the same reference symbol. The composition shown in Fig. 2 is different from the composition shown in Fig. 1 in that a module by-pass circuit is provided for each module, and the isolation devices PC are installed inside the battery assembly Bat. Using the module Md1 as an example, the module by-pass circuit is explained below. Each module by-pass circuit is composed of a pair of a resistor Ri0 and a semiconductor element Qi0 serially connected to each other, and is connected to both terminals of the module composed of cells B1 - B8 in parallel, which are serially connected to each other. Moreover, the module by-pass circuit is driven by a control signal sent from the microcomputer SMC (MC) via the drive circuit DIV. According to the above composition, it is possible to cope with both the charging variation among cells in each module and the charging variation among modules. Also, although the isolation devices PC are installed outside the battery assembly Bat in the embodiment shown in Fig. 1, the isolation devices PC are installed inside the battery assembly Bat. By using the composition shown in Fig. 2, because it is adaptable to various types of composition for the system control unit SYC, the battery assembly Bat can be used with greater flexibility.

[0017] Fig. 3 is the main flow chart of a software program executed in the embodiments according to the present invention. This flow chart shows the process of controlling the battery assembly Bat, which is executed by the system control unit SYC shown in Fig. 1 and Fig. 2. When the process is started, the terminal voltage of each of the modules Md1 - Mdn is read in by the subroutine SUB1. Next, the possible occurrence of an anomaly in the terminal voltage of each of the modules Md1 - Md2 is checked for, and if an anomaly is detected, the processing of a countermeasure to the anomaly is carried out, and this processing is finished. Conversely, if no anomaly is detected, the terminal voltage values of the modules Md1 - Mdn are compared with each other, and the module by-pass circuit is turned on or off based on the result of the comparison among the terminal voltage values. The above process will be explained in more detail with reference to Fig. 4 and Fig. 5.

[0018] Fig. 4 is a flow chart of the subroutine SUB1. The subroutine SUB1 executes the process of reading in the terminal voltage values. Firstly, the number n of the modules is set, and the number 1 is further set to the module number k. Moreover, the system control unit SYC sets the required terminal voltage value Vm1 to the module Md1. After setting the required terminal voltage value Vm1, the microcomputer MC in the module Md1 shown in Fig. 1 sends the measured terminal voltage of each of cells B1 - B8 or the present terminal voltage Vm1 obtained based on the measured terminal voltage of each of cells B1 - B8 to the system control unit SYC. Next, it is determined whether or not the module number k reaches the number n of the modules, and if k is less than n, the process returns to the step following the first step of setting the number n of the modules. Successively, the terminal voltage Vm2 of the module Md2 is read in. The above-mentioned steps are repeated, and if the terminal voltage values of all the n modules are read in, the subroutine SUB1 ends, and the process returns to the main routine shown in Fig. 3.

[0019] Fig. 5 is a flow chart of the subroutine SUB2. The subroutine SUB2 executes the processing of a countermeasure to an anomalous terminal voltage, comparing the terminal voltage values among the modules, and turning on or off each module by-pass circuit. First, the number n of the modules, the reference value Vim for determining an anomalous terminal voltage, and the reference value Vu for turning on each module by-pass circuit are set, and the module number k is further set to the number 1. Next, the terminal voltage Vm1 of the module Md1 is compared with the reference value Vim for determining an anomalous terminal voltage, and if the terminal voltage Vm1 of the module Md1 is higher than the reference value Vim for determining an anomalous terminal voltage, an alarm is generated, an anomalous state is displayed on the display unit SIP, and a countermeasure to the anomaly, such as stopping the operation of the system, is performed. Moreover, the anomalous state is also displayed on the display device IP of the module Md1. If the terminal voltage Vm1 of the module Md1 is not higher than the reference value Vim for determining an anomalous terminal voltage, the average value Va of the terminal voltage values of the n modules is obtained, and the difference between the terminal voltage Vm1 of the module Md1 and the average value Va is also obtained. Furthermore, it is determined whether or not this difference exceeds the

OCID: <EP_ 0932240A2 I >

reference value Vu for turning on each module by-pass circuit, and if it exceeds the reference value Vu for turning on each module by-pass circuit, the module by-pass circuit for the module Md1 is turned on. Otherwise, the module by-pass circuit for the module 1 is turned off. Afterward, it is determined whether or not the module number k has reached the number n of the modules, and if the module number k is less than n, the step of k = k + 1 is executed, and the process returns to the step following the first step of setting the number n of the modules. The above-mentioned steps are then successively repeated for the terminal voltage Vm2 of the module Md2. Furthermore, the above steps are also repeated for each of the remaining modules, and if the processing of all the n modules in subroutine SUB2 are finished, the subroutine SUB2 ends, and the process returns to the main routine shown in Fig. 3. In this embodiment, although the module by-pass circuit for the module is turned on when the difference between the terminal voltage Vm of each module and the average voltage value Va exceeds the reference value Vu for turning on each module by-pass circuit, it is also possible to turn on a module by-pass circuit of each module when the difference between the terminal voltage Vm of each module and the lowest terminal voltage among the terminal voltage values of all the modules exceeds a reference value. As mentioned above, it is a main feature of the present invention that each module includes a module-controlling circuit for controlling cells in the module, which is controlled by at least one microcomputer and receives power from the module itself; and the control function for each module is performed by a system-controlling circuit connected to each module-controlling circuit via an electrical isolation device, based on information bilaterally transmitted between the system-controlling circuit and each module-controlling circuit.

[0020] As mentioned above, in accordance with the present invention, because information is transmitted between each module control unit and the system control unit via the isolation device, the charging variation among the modules is suppressed by controlling the module by-pass circuit provided in each module via each module control unit. More concretely speaking, by connecting each module control unit and the system control unit with the bilateral transmission means and by exchanging information between each module control unit and the system control unit, the charging variation among the modules is thereby suppressed. Thus, the present invention is specially effective for: (1) achieving the full capacity of a battery system, because the charging variation among modules can be reduced; (2) improving the lifetime and the reliability of each module, because the charging variation among modules can be reduced; (3) improving the economic efficiency, because the deterioration over the lifetime of each module can be alleviated; and (4) achieving a simple control of a battery system, because the cell control in each module can be separated from the control of the total battery system. Finally, the present invention is also applicable to other systems that include batteries, such as a power storage system, in addition to an electric vehicle.

Claims

1. A battery system including a battery assembly (Bat) that includes a plurality of modules (Md) connected to each other serially and/or in parallel, for driving electrical loads (MG) by performing a charging or discharging operation, and which is controlled by a system-controlling circuit (DIV, MC, SYC), each of said plurality of modules (Md) including a plurality of battery cells (B) serially connected to each other, said battery system comprising:

   measuring means (SC) for measuring the terminal voltage of each module; and
   a module by-pass circuit (R, Q) connected to each module in parallel, which is for by-passing a part of the charging current for said module;
   wherein said module by-pass circuit (R, Q) is controlled by a control signal sent from said system-controlling circuit (DIV, MC, SYC).

2. A battery system according to claim 1, comprising:

   a module-controlling circuit (MC) for controlling said charging or discharging operation of each module (Md).

3. A battery system including a battery assembly (Bat) that includes a plurality of modules (Md) connected to each other serially and/or in parallel, for driving electrical loads (GM) by performing a charging or discharging operations, and which is controlled by a system-controlling circuit (SYC), each of said plurality of modules (Md) including a plurality of battery cells (B) serially connected to each other, said battery system comprising:

   a module-controlling circuit (MC) for controlling said battery cells (B) in each module, with said module-controlling circuit (MC) including at least one microcomputer and receiving power from said module;
   wherein bilateral transmission (SCD) between each controlling module (MC) and said system-controlling circuit is performed via an electrical isolation device (PC).

4. A battery system according to claim 1, wherein said system-controlling circuit (SYC) includes at least one microcomputer (SMC), and transmission between said system-controlling circuit (SYC) and each module (Md) is performed via a serial transmission port of said microcomputer in said module.

SDOCID: <EP___0932240A2_I_>

5. A battery system according to claim 3, comprising:

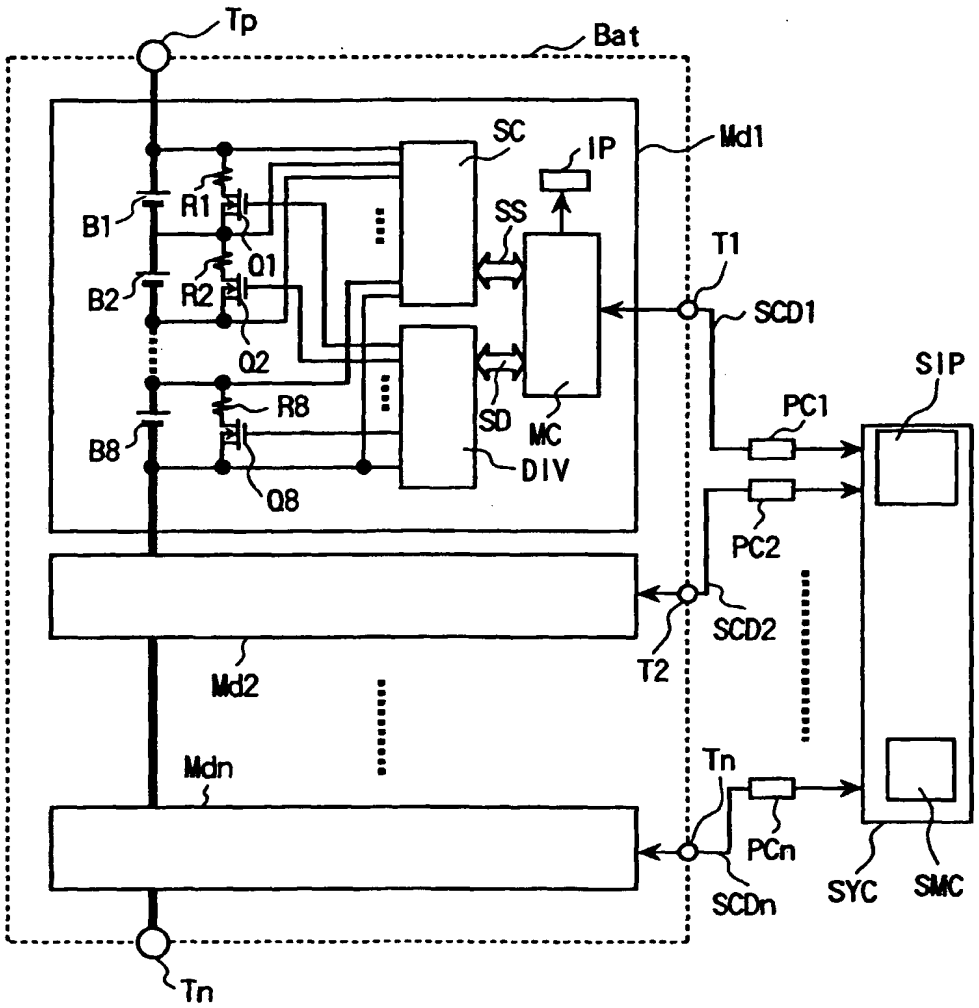
a module by-pass circuit (R, Q) which is connected to each module (Md), controlled by a control signal sent from said system control circuit (SYC), and used for suppressing the charging variation among said plurality of modules (Md).

6. A battery system according to claim 5, wherein by-pass circuits (R, Q) which are provided in each module, are controlled by a control signal sent from said system control circuit (SYC), used for suppressing the charging variation among said plurality of battery cells (B) in said module (Md), and are also used for suppressing the charging variation among said plurality of modules (Md).

7. An electric vehicle (Car) using a battery system according to claim 3 or 5.

IOCID: <EP 0932240A2 I >

FIG.1



9DOCID: <EP___0932240A2_I_>

FIG.2

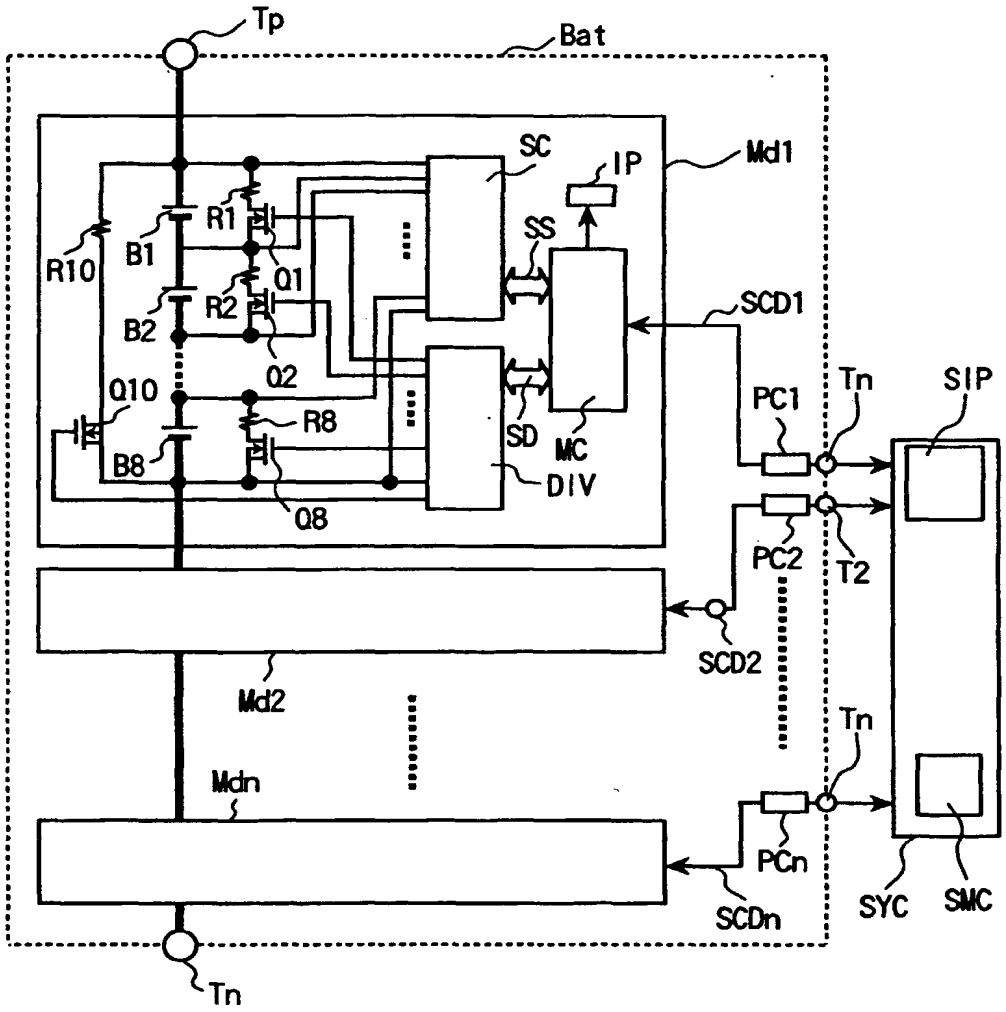
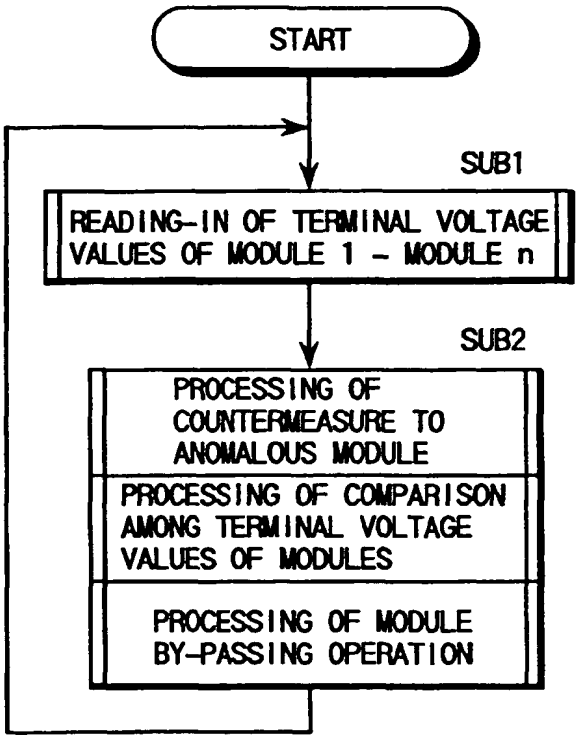

Tp
Bat
SC
IP
Md1
R1
B1
R10
Q1
SS
R2
B2
SCD1
Q2
Q10
R8
PC1
Tn
SIP
SD
MC
B8
DIV
Q8
PC2
T2
SCD2
Md2
Tn
Mdn
PCn
SCDn
SYC
SMC
Tn

FIG.3



SDOCID: <EP___0932240A2_I_>

FIG.4

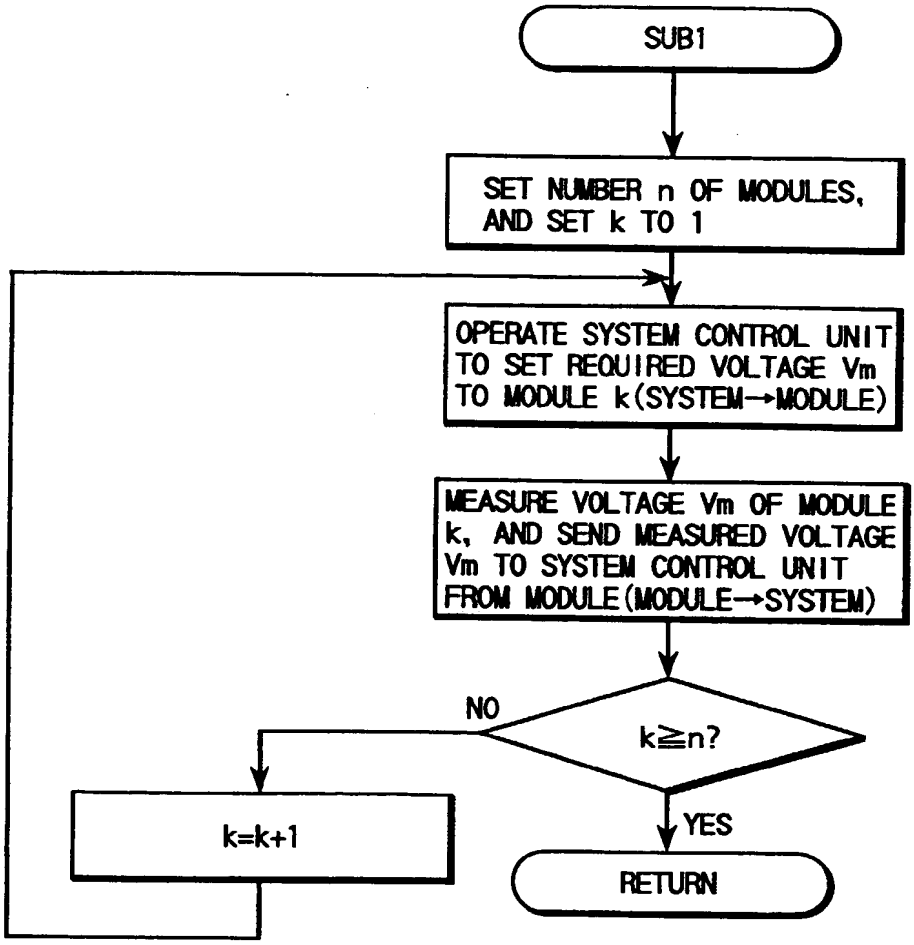
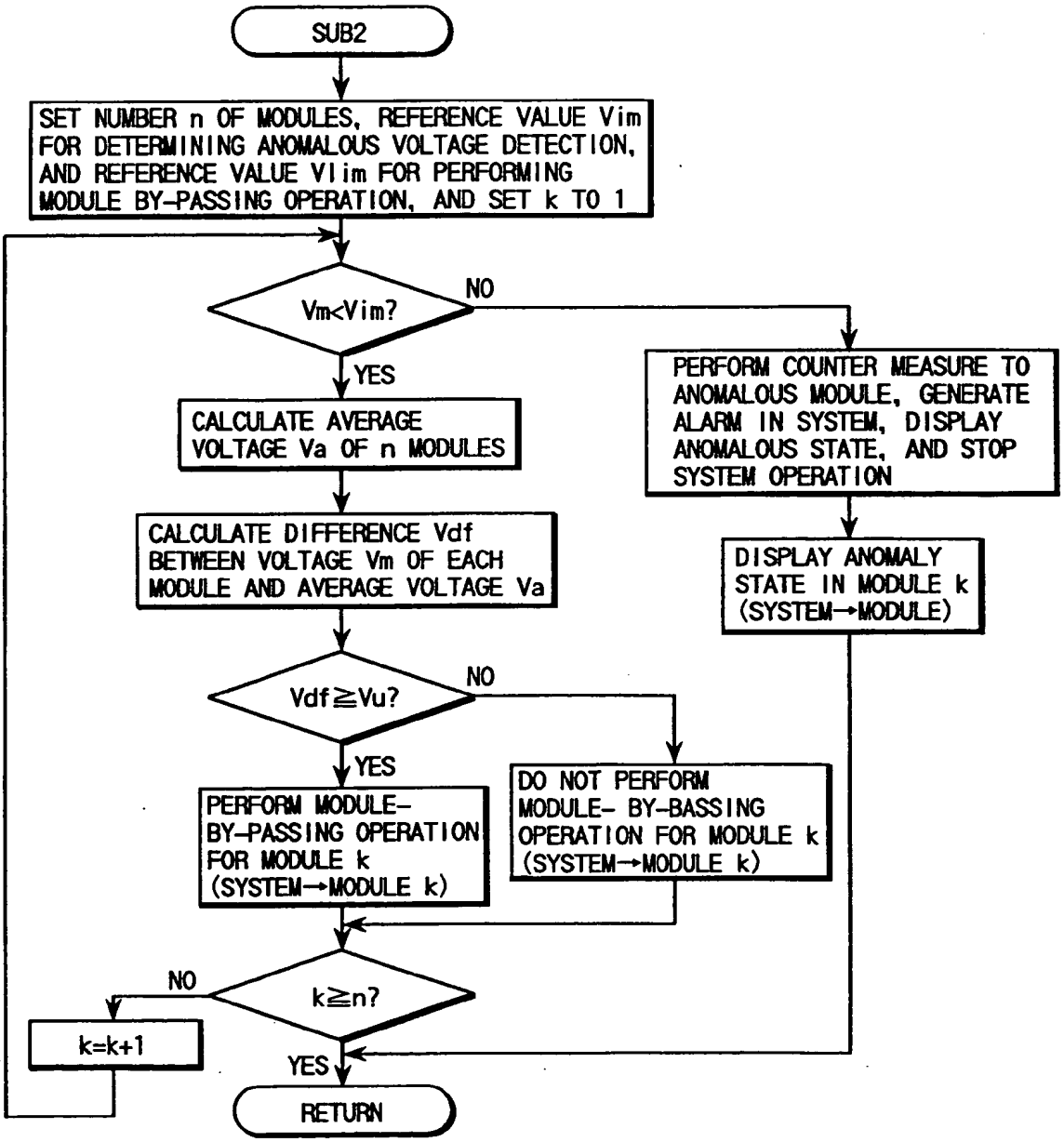

SUB1
SET NUMBER n OF MODULES, AND SET k TO 1
OPERATE SYSTEM CONTROL UNIT TO SET REQUIRED VOLTAGE Vm TO MODULE k(SYSTEM→MODULE)
MEASURE VOLTAGE Vm OF MODULE k, AND SEND MEASURED VOLTAGE Vm TO SYSTEM CONTROL UNIT FROM MODULE(MODULE→SYSTEM)
NO
k≧n?
YES
k=k+1
RETURN

FIG.5



SDOCID: <EP___0932240A2_I_>

FIG.6

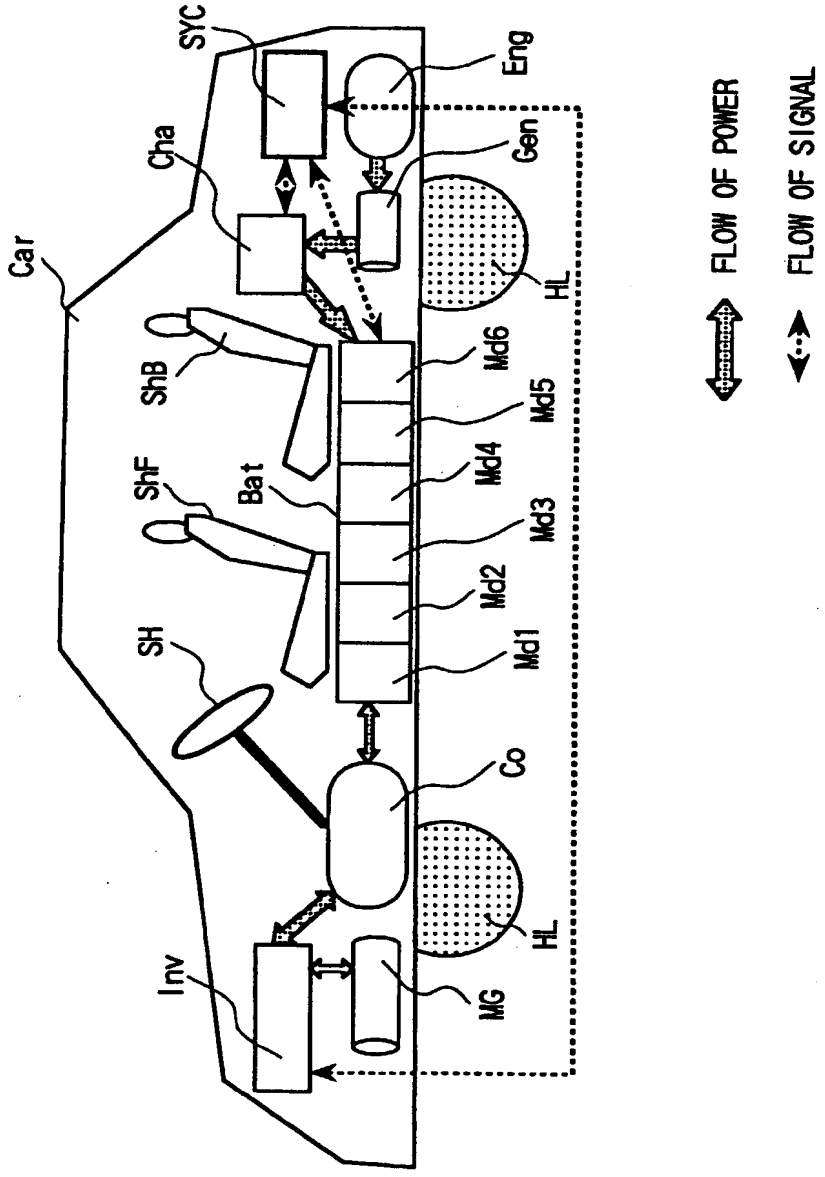

SYC
Eng
Cha
Gen
Car
HL
ShB
Md6
Md5
ShF
Bat
Md4
Md3
Md2
SH
Md1
Co
HL
Inv
MG
FLOW OF POWER
FLOW OF SIGNAL

FIG.7

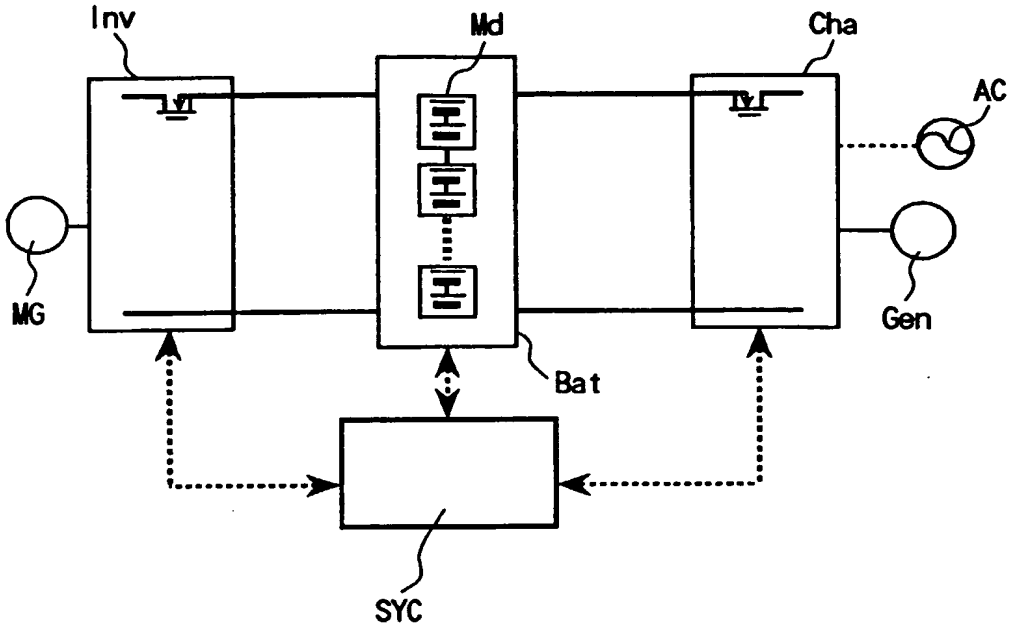
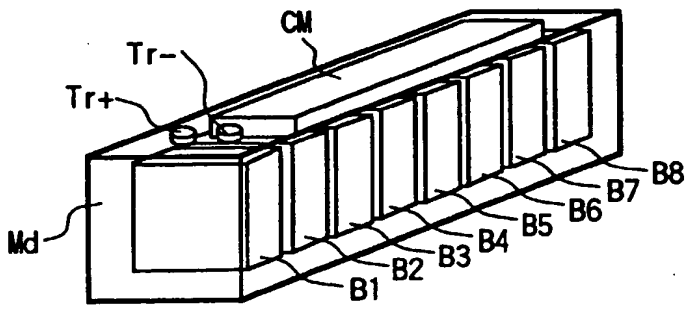


FIG.8



SDOCID: <EP___0932240A2_I_>

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 932 240 A3

(12) EUROPEAN PATENT APPLICATION

(88) Date of publication A3:
25.08.1999 Bulletin 1999/34

(43) Date of publication A2:
28.07.1999 Bulletin 1999/30

(21) Application number: **98124419.7**

(22) Date of filing: **22.12.1998**

(51) Int. Cl.[6]: **H02J 7/02**, H01M 10/48, G01R 31/36, B60L 11/18

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **26.12.1997 JP 35918497**

(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku, Tokyo 101-8010 (JP)

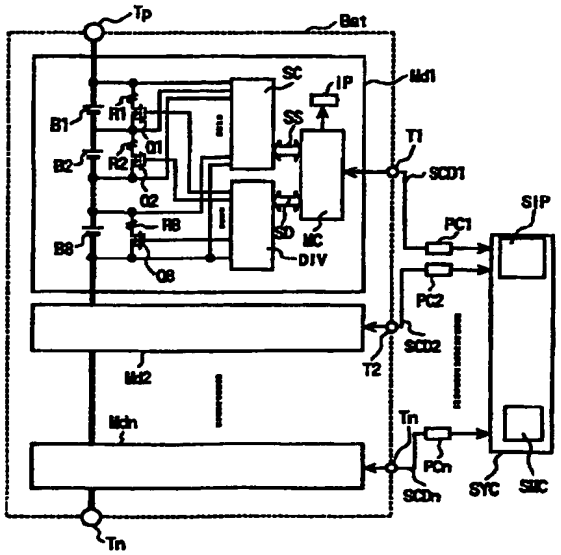
(72) Inventors:
- **Takahashi, Tadashi**
  Hitachi-shi, Ibaraki 319-1225 (JP)
- **Kumashiro, Yoshiaki**
  Hitachi-shi, Ibaraki 316-0006 (JP)
- **Emori, Akihiko**
  Hitachi-shi, Ibaraki 316-0014 (JP)
- **Miyazaki, Hideki**
  Hitachi-shi, Ibaraki 319-1413 (JP)

(74) Representative:
Beetz & Partner
Patentanwälte
Steinsdorfstrasse 10
80538 München (DE)

(54) Battery system and electric vehicle using the battery system

(57) A battery system includes a battery assembly (Bat) including a plurality of modules (Md), which is controlled by a system control circuit (SYC), each module including a module control circuit (MC) and a module by-pass circuit (R, Q) which in controlled via the module control circuit (MC) so as to suppress the charging variation among the plurality of modules (Md); wherein each control circuit (MC) and the system-controlling circuit (SYC) is connected to each other with a bilateral transmission means (SCD), and each module by-pass circuit (R, Q) is controlled based on information bilaterally transmitted between each module control circuit (MC) and the system control circuit (SYC) via the bilateral transmission means (SCD).

FIG.1



EP 0 932 240 A3

SDOCID: <EP___0932240A3_i_>

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 12 4419

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	DE 195 45 833 A (BMW) 12 June 1997 * the whole document *	1-7	H02J7/02 H01M10/48 G01R31/36 B60L11/18
X,P	EP 0 814 556 A (FORD) 29 December 1997 * column 3, line 38 - line 54 *	1-7	
X	WO 95 15604 A (ELECTRONIC POWER TECHNOLOGY INC.) 8 June 1995 * claims 1,6,10 *	1-4	
A		5,6	
X	US 5 153 496 A (LAFORGE) 6 October 1992 * claim 1 *	1-4	
A		5,6	
X	US 5 387 857 A (HONDA ET AL.) 7 February 1995 * claims 1,9; figures 2,6 *	1-3	
A		5,6	
X	US 5 578 914 A (MORITA) 26 November 1996 * claims 1,3,7,10 *	1-3	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A		5,6	H02J H01M G01R B60L
X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 011, 28 November 1997 & JP 09 200968 A (NISSAN MOTOR CO LTD), 31 July 1997 * abstract *	1-3	
A		5,6	
X	PATENT ABSTRACTS OF JAPAN vol. 097, no. 011, 28 November 1997 & JP 09 182307 A (NISSAN MOTOR CO LTD), 11 July 1997 * abstract *	3	
A		1,2,5,6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	15 April 1999	MEHLMAUER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

)OCID: <EP 0932240A3 I >

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 98 12 4419

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

15-04-1999

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19545833 A	12-06-1997	NONE	
EP 814556 A	29-12-1997	US 5764027 A	09-06-1998
		JP 10066270 A	06-03-1998
WO 9515604 A	08-06-1995	US 5504415 A	02-04-1996
		AU 1300595 A	19-06-1995
US 5153496 A	06-10-1992	CA 2089006 A,C	28-03-1992
		EP 0550620 A	14-07-1993
		JP 7503355 T	06-04-1995
		WO 9206525 A	16-04-1992
US 5387857 A	07-02-1995	JP 4299032 A	22-10-1992
		DE 69216869 D	06-03-1997
		DE 69216869 T	07-05-1997
		EP 0498679 A	12-08-1992
		JP 5064377 A	12-03-1992
US 5578914 A	26-11-1996	JP 7336905 A	22-12-1995

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ISDOCID: <EP___0932240A3_I_>